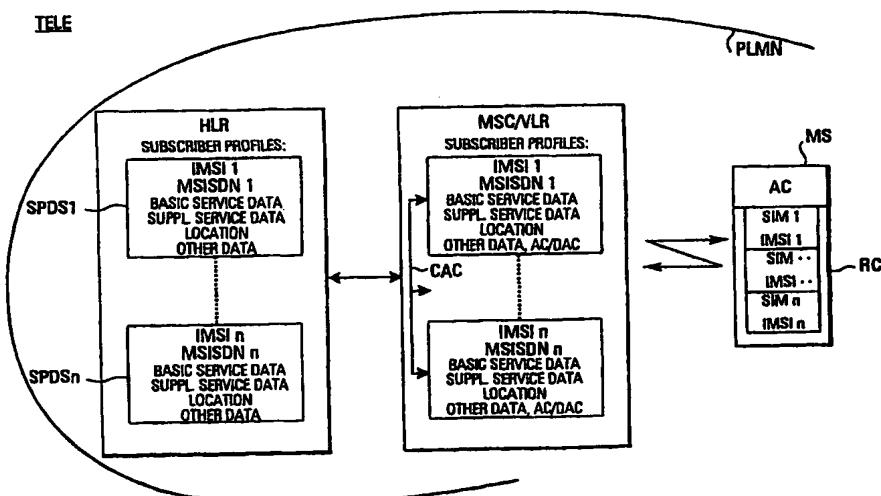




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(54) Title: MOBILE STATION, MOBILE RADIO COMMUNICATION NETWORK AND COMMUNICATION METHOD USING SEVERAL SUBSCRIBER PROFILES



(57) Abstract

A mobile station (MS) has a receiving means (H) for receiving two or more subscriber identity modules (SIM1-SIMn) each having stored in a home location register (HLR) of a network (PLMN) a corresponding subscriber profile data set (SPDS1...SPDSn). The mobile station (MS) comprises an activation/deactivation means (AC) for selectively activating/deactivating one or more of said subscriber identity modules (SIM1-SIMn) inserted in the mobile station (MS). The subscriber can use selectively and simultaneously services from several subscriber profile data sets (SPDS1...SPDSn) which belong to the same subscriber and which have been stored in a home location register (HLR) and in the mobile switching center/visitor location register (MSC/VLR) handling the communication in a cell where the mobile station (MS) is located. When several subscriber identity modules (SIM1-SIMn) belong to different users, the mobile station (MS) can thus be used commonly by several users.

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MOBILE STATION, MOBILE RADIO COMMUNICATION NETWORK AND
COMMUNICATION METHOD USING SEVERAL SUBSCRIBER PROFILES

Background of the Invention

15 The invention relates to a mobile station, a mobile radio communication network and a communication method for performing communications using several subscriber profiles. In particular, the invention relates to mobile radio communication networks in which the end terminals 20 (mobile stations) are controlled by so-called subscriber identity modules (SIMs).

Fig. 7 shows a telecommunication system TELE comprising at least one public land mobile radio communication network PLMN in which a number of mobile stations MS1-MS4 perform communications by means of an exchange EX comprising at least a home location register HLR and a mobile switching center/visitor location register MSC/VLR. As is illustrated with the mobile station MS4, in such a network PLMN the 30 subscriber (user) can use any mobile telephone (and terminal) by inserting a specific plug-in unit PIU1-PIU4 into the mobile station MS4. The plug-in unit is a conventionally known SIM-card. The SIM-card, which the subscriber has bought from the provider, contains a 35 subscriber identity which is allocated to a directory number. If the network PLMN is of a GSM-type, then the subscriber's identity is the IMSI and the directory number is the MSISDN.

40 When the subscriber acquires the SIM-card from the provider, he/she buys a number of subscribed services

5 (basic and supplementary services) and the subscribed services, the IMSI, the MSISDN and other information relating to the subscriber is stored permanently as a data record in the home location register HLR by the provider of the network. The subscriber (user) may obtain several
10 different SIM-cards from the provider, for example to have subscriptions for different types of services, and therefore the home location register HLR can have a number of subscriber profiles each identified by the combination of IMSI and MSISDN.

15

When a particular SIM-card has been inserted into the mobile station MS4 and the mobile station roams into different local areas of the network PLMN, then a copy of the subscriber data (a subscriber profile) relating to the
20 inserted SIM-card is copied to the mobile switching center/visitor location register MSC/VLR, wherein the visitor location register VLR contains data as to where the mobile station MS4 is currently located.

25 Fig. 1 only shows those parts of a conventional PLMN network, which are necessary to understand the background of the invention. However, of course the PLMN network comprises all functionalities normally used in a mobile radio communication network, such as a base station system
30 BSS, base station controllers BSC and numerous mobile switching centers MSC serving different service areas (e.g. cells of the network) of the PLMN network. Signaling which is necessary to perform such communications between the mobile stations MS1-MS4 is for example described in the
35 ETSI Recommendations for the European GSM network.

Description of the Prior Art

For PLMN networks of the GSM-type a particular service
40 using multiple subscriber profiles MSPs enabling the mobile stations to have several subscriber profiles has already

5 been partially standardized by ETSI (reference [1]: Digital
Cellular Communication System (Phase 2+); Multiple
Subscriber Profile (MSP) Service Description, Stage 1 (GSM
02.97), Version 5.0.0, July 1996; Reference [2]: Digital
Cellular Telecommunications System (Phase 2+); Multiple
10 Subscriber Profile (MSP) - Stage 2 (GSM 03.97), Version
0.2.0, October 1996; Reference [3]: GSM 09.02, Version
5.0.0, May 1997, pages 293-326). However, no signalling
procedures for MSP but only general GSM procedures are
described in these documents.

15

According to this prior art, the multiple subscriber profile service is an optional service to enable mobile subscribers to have several profiles associated with a single SIM and a single IMSI, wherein each profile is a subscription option. Each profile may be used for mobile originated and mobile terminated calls. A subscriber profile consists of a set of basic services for the subscriber. In the case of the single numbering scheme there is a unique MSISDN associated with each profile. In the multi-numbering scheme there is the ability to have a unique MSISDN associated with each basic service in each profile. The profile (subscriber) data is a set of subscriber data (identified by a unique MSISDN in the case of the single numbering scheme or several MSISDNs in the case of the multi-numbering scheme) and may include operator determined barring data, roaming restriction data, subscription restriction data, basic service data and supplementary service data. A selected profile is the currently registered profile unless an alternative profile is selected by the subscriber on a per call basis and used for outgoing calls and supplementary service activation. There is also defined a default profile, which is the profile to be used when the subscriber is roaming to non-supporting networks.

5 As shown with the mobile station MS1 in Fig. 7, the ETSI standards using the MSP feature currently recommend up to four different profiles P1-P4 on one MSP-SIM card, i.e. the MSP-SIM card is a card with up to four profiles belonging logically to one provider. This will allow the subscriber
10 to separate his telecommunication service needs into different categories (e.g. business and home). The charges incurred for the services will then be associated with the appropriate profile which allows a separate charging for each profile.

15

Fig. 7 also shows another possibility not using the MSP feature where into the mobile station MS4 one of four different cards each having a specific profile stored thereon is inserted.

20

The aforementioned references [1], [2], [3] of the prior art describe the functional requirements for the handling of the MSP service in a GSM network. Typical functional requirements are for example the "attach procedure" when a
25 mobile station is switched on and tries to connect to the mobile switching center/visitor location register MSC/VLR of the network PLMN requiring the provision of a particular set of subscriber data of a particular selected subscriber profile, the "detach procedure" when the mobile station
30 desires to disconnect from the network PLMN, the "location updating and location cancellation procedure" for updating location data of the mobile station when it moves to an area served by another VLR and the "subscriber data updating procedure" for changing data in subscriber
35 profiles already set up in the home location register HLR.

The above procedures have been subjected to extensive standardization as may be taken from the references [1]-[3] and no further description will be made here.

40

5 Problem of the prior art

As already mentioned above, one possibility is (e.g. in fig. 7 for MS4) that a first SIM-card PIU1 may relate to a "business subscriber profile" which will be used when this 10 SIM-card PIU1 is inserted in the mobile station MS4.

Alternatively, for example the SIM-card PIU2 may be related to a special "private subscriber profile" which will be used when the SIM-card PIU2 is inserted in the mobile station MS4. A separate charging for each profile is 15 enabled, however, the distribution of the costs for example for business and private calls can cause problems and involve extra work. For example, one user may want to use one subscriber profile during the day for business calls and during the evening for private calls. However, once the 20 SIM-card has been inserted, there is no possibility of further distinguishing or distributing costs charged for this SIM-card for different types of use or for different users.

25 Furthermore, the requirements of one user regarding the needed telecommunication services may also be different for the private and business use. However, again once the SIM-card has been inserted, the user is fixed to the selected subscriber profile which has been allocated for the 30 inserted SIM-card in the home location register HLR.

Furthermore, for example in a company, several users may use the same company SIM-card at different times and there is no possibility to distribute the costs among the several 35 users, since there is only one account (or counter) within the mobile switching center/visitor location register MSC/VLR counting the incurred charges for the single card. Therefore, unless the single user notes separately when business calls or private calls were made on the same card 40 or unless different users note when they have used the SIM-card, there is no further possibility to specifically

5 distribute the costs and/or to select for example different services for a private call and a business call as soon as the single card has been inserted into the mobile station. On the other hand, there is also an existing solution called "discount codes" where the user gives with each call
10 some additional information (e.g. by pressing the addition key) to indicate e.g. the account for that call.

The solution to the above problem which is currently standardized for the GSM MSP supplementary service by ETSI
15 is to provide several subscriber profiles under one single IMSI (i.e. the afore mentioned MSP service). As the reference [1] describes, using the conventional MSP service in the GSM network, the subscriber can separate his telecommunication service needs into different entities
20 like business calls and also private calls. That is, instead of buying two cards each associated with a particular subscriber profile, the user obtains a single card having a single subscriber identity IMSI and one or more directory numbers MSISDNs allocated to it. Under this
25 single IMSI multiple subscriber profiles are available to the user. However, this solution is very cumbersome since it requires a restructuring of the subscriber profile structure in the visitor location register VLR and the home location register HLR. Furthermore, additional fields for
30 billing related services (Advice of Charge) on the SIM-card are necessary. Whilst the user may thus select a particular subscriber profile under one subscriber's identity IMSI, all subscriber profiles must be associated with one service provider (since only one IMSI is used). Furthermore, the
35 single IMSI solution does not give the user any flexibility and control over the profiles in terms of which profiles are possibly simultaneously active and which profile shall be accessible in a network not supporting the MSP service. Further disadvantages of the MSP service with respect to
40 implementing this service in an existing network is that

5 the HLR has to be changed and that the individual SIMs have
to be changed for all users.

Similar functionalities already exist in systems like the Dual Numbering/Alternate Line Service which aims to provide
10 a business and a private line. However, such a system does not offer completely separate subscriber profiles, but only an additional line (a new number MSISDN, under which the user is reachable) for the telephony service. Other basic services (like Fax, Data, SMS) and supplementary services
15 are not available, but are shared between the two lines.

Summary of the Invention

Thus, the problem of the invention is

20 - to provide a mobile station, a mobile radio communication network and a communication method using several subscriber profiles, which provide each user with a flexible control over several subscriber
25 profiles to which each user has a subscription.

Solution of the Object

This object is solved by a mobile station according to
30 claim 1. Furthermore, this object is solved by a method according to claim 11. Furthermore, this object is solved by an exchange according to claim 30. The object is also solved by a telecommunication system according to claim 37. An advantage of the invention is in particular that a
35 single mobile station loaded with several cards belonging to different users can be shared among the different users.

According to a first aspect of the invention (claims 1,
40 11) the mobile station has a receiving means for receiving two or more subscriber identity modules for which a home location register of the network has respectively stored a

5 corresponding subscriber profile data set. The mobile station comprises an activation/deactivation means for selectively activating/deactivating one or more of said subscriber identity modules for a communication in the network. That is, according to this aspect of the invention
10 several SIM-cards or one SIM-card including a plurality of subscriber identity modules are received in the mobile station and can be activated simultaneously. The user can thus actively use different subscriber profile data sets stored in the home location register selectively or
15 simultaneously. This allows greater flexibility and the user can use different subscriber identity modules separately which allows a flexible charging of the calls respectively made with the respective subscriber identity module.

20

According to a second aspect (claims 30, 37) of the invention a mobile radio communication network comprises at least one home location register storing a plurality of subscriber profile data sets for each subscriber of a
25 mobile radio communication network. When the mobile switching center of the mobile radio communication network receives a registration message from a mobile station, the plurality of subscriber profile data sets stored permanently in the home location register for each
30 subscriber are copied to the visitor location register such that the visitor location register where a mobile station is currently located contains simultaneously several subscriber profile data sets for each user. Since the visitor location register comprises the plurality of
35 subscriber profile data sets, the user can after activating a specific subscriber identity module in the mobile station use selectively one or more of the subscriber profile data sets stored in the visitor location register.
40 According to a third aspect (claims 2, 3) of the invention the subscriber identity modules are provided on a single

5 SIM-card and the receiving means comprises a single SIM-card slot for receiving the single SIM-card. Alternatively, the subscriber identity modules may be provided on separate SIM-cards and the receiving means comprises several SIM-card slots for receiving the separate SIM-cards. Whilst the
10 former alternative allows an easy replacement of several subscriber identity modules, the latter alternative allows the replacement of a specific subscriber identity module while keeping the other subscriber identity modules in the mobile station.

15

According to a fourth aspect (claim 4) of the invention the mobile station is provided with a display means which indicates to the user which of the received subscriber identity modules are active. Preferably, the display means can also indicate which of the activated subscriber identity module have been successfully registered in the network (i.e. in the visitor location register). Further preferably, the display means can indicate the available basic services and the supplementary services for each subscriber identity module and/or default subscriber identity module and/or the complete data of the respective subscriber profile data set stored in the visitor location register. Therefore, advantageously the user can always be informed of the present state and operation possibilities
25 for performing calls from the mobile station.
30

According to a fifth aspect (claims 5, 6) of the invention the activation/deactivation means of the mobile station selects a specific subscriber identity module for
35 activation in accordance with the specific characteristics of a desired call. For example, when one subscriber identity module is to be provided specifically for private calls, then the user can press a "private" button on the mobile station which selects the specific subscriber identity module provided for such private calls. Preferably a default setting means is provided for setting one of the
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5 subscriber identity modules as a default module. This can be done by a user or automatically by the mobile station, for example by always regarding the SIM-card in a specific slot as a default module.

10 According to a sixth aspect (claims 7, 14, 31) of the invention a subscriber identity module addressing parameter is sent from an exchange of a telecommunication system to a mobile station when a mobile terminating call is pending at the exchange. The subscriber identity module address

15 parameter indicates that a call directed to the IMSI currently used in a particular mobile station uses one (or more) specific subscriber profile data set corresponding to a specific subscriber identity module in the mobile station. In turn, the mobile station comprises a selection

20 means for selecting the specific (or several specific) subscriber identity module as indicated in the subscriber identity module addressing parameter. Since the subscriber identity module addressing parameter indicates a specific subscriber profile data set already registered in the

25 present visitor location register, the user of the mobile station does not have to manually select the subscriber identity module corresponding to the used subscriber profile data set.

30 According to a seventh aspect (claims 8, 9, 12, 13, 15, 16, 17) of the invention the activation/deactivation means sends a registration message to the switching means of the network, wherein the registration message includes a list of identifies identifying the subscriber identity modules

35 in the mobile station which have been activated. The registration message requests from the switching means the storage of subscriber profile data sets corresponding to the activated subscriber identity modules from at least one home location register in the switching means. Thus, the

40 respective visitor location register of the switching means where the mobile station is currently located contains the

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5 subscriber profile data sets of all activated subscriber identity modules. Preferably, in a GSM-network such a registration message is a Location_Update_Request Message containing a List of IMSIs identifying the activated subscriber identity modules to a mobile switching
10 center/visitor location register of the mobile radio communication network. The mobile switching center/visitor location register forwards this registration message to one or more home location registers which then return an Insert_Subscriber Data_Request Message containing the
15 requested subscriber profile data sets corresponding to the IMSIs to the respective visitor location register. The sending of a registration message and the corresponding copy procedure to copy a subscriber profile data set from a home location register to a respective visitor location
20 register is repeated whenever a subscriber identity module is activated in the mobile station. When the registration has been finalized, indication parameters indicating to the mobile station the subscriber identity modules which have been successfully registered by the network can be provided
25 to the mobile station. Preferably the display means can then indicate which of the activated subscriber identity modules have been successfully registered in the network.

According to an eighth aspect (claims 10, 18) of the
30 invention the IMSIs used for identifying the mobile station identity associated with the subscriber identity module are temporary allocated IMSIs. Thus, the safety can be improved.

35 According to a ninth aspect (claims 19, 20) of the invention the mobile station sends a detach message to the switching means, wherein the detach message includes an identifier which identifies the deactivated subscriber identity module in the mobile station. The switching means
40 of the network can preferably send a single detach request message for each identifier (subscriber identity module) to

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5 a respective home location register or a multiple detach request message containing all identifiers of all deactivated subscriber identity modules.

According to a 10th aspect (claims 20, 21, 33, 34) of the invention each subscriber profile data set stored in a home location register or a respective visitor location register comprises an identifier indicating that a subscriber profile data set belongs to a specific subscriber, a directory number parameter, basic service data, 15 supplementary service data, location data and a busy parameter indicating whether a specific subscriber identity module in the mobile station is activated. The subscriber profile data set may also comprise in addition to the busy parameter a so called active/inactive parameter indicating 20 that a user has registered a particular IMSI. Advantageously, the busy parameter can be used in order to determine whether a communication has already been set up between the switching means and the mobile station, such that a separate communication channel does not have to be 25 set up when an additional subscriber profile data set/subscriber identity module is used for a communication. Therefore, a paging message during a connection establishment procedure for a mobile terminating call is only sent to the mobile station when all busy parameters in 30 the respective subscriber profile data sets have an non-busy status.

According to an 11th aspect (claim 23) of the invention the registration message from the mobile station may not only 35 contain an identifier for a newly activated subscriber identity module, but also the identifiers for all subscriber identity modules which have previously been activated and registered in the network. This advantageously enables the switching means of the network 40 to establish or update the cross-links between the individual subscriber profile data sets in the visitor

5 location register and/or the home location register. In a case where the registration message contains only one identifier, the switching means (i.e. the mobile switching center of the network) can keep a record of all identifiers of previously activated and registered subscriber identity
10 modules in a memory and can generate the full list of all identifiers from the previously stored identifiers and the new identifier contained in the registration message.

According to a 12th aspect (claims 24, 35) of the invention
15 the subscriber profile data sets stored in the visitor location register for activated subscriber identity modules of the same subscriber may be linked through common links (link channels). Thus, subscriber profile data of one subscriber profile data set can be used commonly by calls using one or more other subscriber profile data sets. In this case the aforementioned subscriber identity module addressing parameter should indicate that a call uses also subscriber profile data from a different data set, such that the mobile station will immediately "tune" in or
20 switch-on the respective subscriber identity modules in the mobile station, for example after prompting the user whether he/she allows a reception on his/her other IMSI.
25

According to a 13th aspect (claims 25, 26) of the invention, when the mobile stations roams from one servicing area to another servicing area, the mobile switching center/visitor location register responsible for the first servicing area may send a location updating request message to one or more home location registers in order to request the copying of respective subscriber profile data sets into a mobile switching center/visitor location register responsible for these other servicing area. This location updating request may be sent repeatedly for all activated subscriber identity modules or as a common locating updating request including all identifiers of all activated subscriber profile modules.
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According to a 14th aspect (claims 28, 29) of the invention, when the mobile station roams to another network, which does not allow several subscriber profiles (i.e. subscriber identity modules) to be activated and registered simultaneously, the switching means of the another network sends a location updating reponse message indicating that the location updating can only be performed for one subscriber identity module. The switching means of the other network then performs a location updating procedure either for a default subscriber identity module or in response to a specific default selection made by the user. Thus, the transition from a network allowing a registration and activation of several subscriber profiles (i.e. subscriber identity modules) to a network not allowing this is possible. Two cases can be distinguished when the mobile station roams to another network. When several subscriber identity modules are active and the new network can only support one subscriber identity module then the new network can perform the updating only for the subscriber identity module which the new network has itself defined as a default. Alternatively, if the new network only supports one subscriber identity module, the user himself/herself may also set a default subscriber identity module which is to be used by the new network.

30

Hereinafter, the invention will be described with reference to its preferred embodiments and with reference to the attached drawings. In the drawings the same was similar reference numerals designated the same or similar parts or steps throughout.

Brief Description of the Drawings

In the drawings:

40

15

5 Fig. 1 shows a mobile radio communication network PLMN comprising a home location register HLR and a mobile switching center/visitor location register MSC/VLR and a mobile station MS as part of a general telecommunication system TELE according
10 to the invention;

Fig. 2 shows a mobile station including a housing to receive a multiple SIM-card comprising a plurality of subscriber identity modules SIM₁-SIM_n according to the invention;
15

Fig. 3 shows a mobile station including a housing for receiving a plurality of subscriber identity modules SIM₁-SIM_n separately according to the invention;
20

Fig. 4 shows simultaneously the location updating and attach procedures for several IMSIs according to the invention;
25

Fig. 5 shows a simultaneous detach for several IMSIs according to the invention;

Fig. 6 shows an updating of a subscriber profile data set for several IMSIs according to the invention;
30

Fig. 7 shows an overview of a telecommunication system TELE using a multiple subscriber profile service according to a conventional GSM standard.
35

Principle of the Invention

Fig. 1 shows an overview of a telecommunication system TELE of a mobile radio communication network PLMN according to
40 the invention. As already explained with reference to Fig. 7 of the prior art, the conventional means for carrying out

16

5 the communications between several mobile stations MS like the base station system BSS and the base station controllers BSC are not illustrated in Fig. 1 since they do not form a part of the invention.

10 The network PLMN generally comprises a switching means which is responsible for switching calls between mobile stations MS within a cell. The network also comprises a home location register HLR and as switching means a mobile switching center/visitor location register MSC/VLR.

15 Although not illustrated in Fig. 1 and in Fig. 7, it should also be noted that the invention is not restricted to the usage of only one mobile radio communication network PLMN, i.e. the telecommunication system TELE can also comprise several mobile radio communication networks PLMN or a

20 public switched telephone network PSTN in combination with one or more mobile radio communication networks PLMN. That is, the telecommunication systems TELE may comprise several home location registers HLRs and of course each mobile radio communication networks PLMN comprises one or more

25 visitor location registers VLR and mobile switching centers/visitor location registers MSC/VLR depending on the number of service areas (e.g. cells of the network) serviced by the mobile radio communication network PLMN.

30 A mobile station MS performs communications in such a telecommunication system TELE which may include at least one mobile radio communication network PLMN. The invention is to replace the multiple subscriber profiles MSP as generally discussed in Fig. 7.

35

Embodiment of the mobile terminal equipment

As indicated in Fig. 1, the mobile station MS according to the invention comprises a receiving means RC for receiving

40 two or more subscriber identity modules SIM1-SIMn each having stored in a home location register of the at least

5 one network PLMN a corresponding subscriber profile data set (to be described in more detail below) SPDS1...SPDSn simultaneously. Furthermore, the mobile station MS comprises an activation/deactivation means AC for selectively activating/deactivating one or more of said
10 subscriber identity modules for a communication in the network. That is, a subscriber can use several subscriber identity modules SIMs in a single terminal (mobile station). This is done to allow the subscriber (user) to access a respective subscriber profile data set
15 SPDS1...SPDSn in the home location register HLR (or respectively in the MSC/VLR) corresponding to each subscriber identity module SIM through a single terminal or mobile station. The activation/deactivation means AC allows the user to selectively activate subscriber identity
20 modules SIMs which he/she intends to use for a communication, preferably even simultaneously (to be explained below).

Fig. 2 shows an embodiment of the mobile station MS shown
25 in Fig. 1. Here several subscriber identity modules SIM1-SIMn are provided on a single SIM-card MSIM and a receiving means H, e.g. a housing H of the mobile station MS, comprises a single SIM-card slot MSL for receiving that single SIM-card MSIM. The user inserts the single SIM-card
30 MSIM into the single SIM-card slot to use one or more of the subscriber identity modules SIM1-SIMn provided thereon. Of course the invention is not restricted to the insertion of cards into a slot and other means for holding and inserting the MSIM into the mobile station may be used, for example a
35 rear cover may be opened to access a card holding device in the mobile station.

Fig. 3 shows another embodiment of the mobile station MS according to the invention. Here the subscriber identity
40 modules SIM1-SIMn are provided on separate SIM-cards SIM1-SIMn and the receiving means RC provided in the housing H

5 of the mobile station MS comprises several SIM-card slots SL₁-SL_n for receiving the separate SIM-cards SIM₁-SIM_n. Thus, the subscriber identity modules SIMs can be provided on one physical card each (Fig. 3) or on a single card (Fig. 2). Independently as to whether the configuration in
10 Fig. 2 or Fig. 3 is used, essential for the invention is that the activation/deactivation means AC of the mobile station MS has the possibility to select or activate/deactivate several ones of the subscriber identity modules instead of only having one such module provided in
15 the mobile station MS as shown in the prior art in Fig. 7.

When the user has inserted the multi-SIM card MSIM (Fig. 2), or several SIM cards SIM₁... SIM_n (Fig. 3) the user can enable or disable the inserted SIMs individually. For
20 example when the activation/deactivation means AC can comprise buttons, switches, commands or menus indicated on a display means DSP. For example, when the user has inserted the subscriber identity modules he/she may be prompted to select which ones should be activated. The user
25 may also be provided with information regarding the subscriber profile data set associated with each subscriber identity module on a display screen DSP. Once the subscriber identity module has been activated, such activated or enabled SIMs will be considered by the mobile
30 station for all relevant procedures necessary for the communication. Disabled or deactivated SIMs will not be considered for any function and will simply be kept in the receiving means (slot) for user convenience. The user can also be provided with a menu function which displays the
35 activated and the deactivated cards. The user can also be predefine certain keys to activate specific subscriber identity modules.

The user can also press a default setting means DSM for
40 setting one of said subscriber identity modules as a default module. There are two different possibilities of

5 default setting. One possibility is where the user
prefetches which ones of the inserted subscriber identity
modules he/she wants to have registered as default
subscriber identity modules in case the subscriber moves to
a non-supporting network. The other possibility is one
10 where the user prefetches a default subscriber identity
module to be used as default when performing an outgoing
call.

Furthermore, the terminal (mobile station) can provide
15 means to indicate to the user which of the activated SIMs
are also successfully registered in the network and/or have
been rejected by the network. This can be done by means of
messages displayed on the display means DSP or by means of
LEDs which change color according to the status of the
20 respective inserted subscriber identity module. For
example, an indicator (such as an LED) may be red when a
specific subscriber identity module has been inserted in
the mobile station, the LED may change the color to orange
when the subscriber identity module has been activated in
25 the mobile station and the LED may change the color to
green, once the subscriber identity module has been
successfully registered in the network (when the subscriber
profile data set is available in the relevant visitor
location register VLR). Furthermore there may be an
30 indication of the default subscriber identity module which
has been set as default for performing outgoing calls.

Once, the several subscriber identity modules SIM1... SIMn
have been activated and registered in the network, the user
35 can originate calls or receive calls. For calls (speech
calls, data calls, SMS) originating from the terminal, the
user has to select a specific subscriber identity module
SIM for the call he wants to establish. When the user does
not select a specific SIM according to his/her choice, the
40 mobile station default setting means DSM will offer a
default subscriber identity module SIM. The mobile station,

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5 for example the display means, will indicate to the user (either permanently or upon request of the user) which subscriber identity module SIM is declared as the default SIM either by the mobile station itself or predefined as default by the user. If the user wants to originate a
10 specific call (for example a private call or a business call) he presses a selection means SEL (Fig. 2, 3) to select the specific subscriber identity module according to his/her choice. The selection means SEL can again be a button or a switch on the mobile station MS. For example,
15 the user can press the selecting means SEL repeatedly to browse through several subscriber profile data sets displayed on the display means DSP until he/she will find a profile (SIM card) which provides basic services and/or supplementary services the user intends to use for the
20 particular call.

As will be explained with more details below, after the user has activated several subscriber identity modules in the mobile station MS, the registration procedure in the
25 network of such activated subscriber identity modules means that the visitor location register VLR currently responsible for handling traffic from the mobile station receives a copy of several subscriber profile data sets. Therefore, in principle even for a mobile station
30 originating call the user can in principle also select two subscriber identity modules SIMs simultaneously. That is, the subscriber may require (for the particular call he intends to originate) some basic services from a first subscriber identity module (e.g. from a first subscriber profile data set) and some supplementary services from a second subscriber identity module (e.g. a second subscriber profile data set). Thus, during the selection process the user can also be prompted to select features from several activated subscriber identity modules to set up a call. The
35 user can also predefine combinations of services (subscriber data) from several ones of his/her subscriber
40

5 identity modules. Such combinations can be stored and can
be called up through a switch or button on the keyboard of
the mobile station, such that the user does not have to
undergo the selection procedure whenever he wants to
initiate a particular call having particular
10 characteristics.

The mobile station MS according to the invention also
comprises similar means for the analogous case when a call
is directed to the mobile station (mobile station
15 terminating a call). That is, a call may be directed to the
mobile station using features as defined and allowed for a
specific subscriber profile data set (or for the
corresponding subscriber identity module in the mobile
station MS). For example, a case may occur where the mobile
20 station has currently activated and registered a specific
subscriber identity module (or its respective subscriber
profile data set) and the call directed to the mobile
station can actually only be received by selecting another
(activated or non-activated) subscriber identity module. In
25 this case, the exchange means EX can preferably provide a
subscriber identity module addressing parameter SAP to the
mobile station MS dependent on the characteristics of the
mobile station terminating call. Such subscriber identity
module addressing parameters SAPs may be negotiated with
30 the exchange EX during the registration procedure. That is,
a selection means SEL in the mobile station will recognize
that a currently pending call to the mobile station uses
specific features of a specific subscriber identity module.
The selection means SEL can then indicate (for example on
35 the display means DSP) for the user that a specific SIM
needs to be selected (or activated) to accept the call. If
the specific SIM needed has already been activated and
registered, the selection means SEL of the mobile station
MS can also use this subscriber identity module addressing
40 parameter SAP to automatically (or after prompting the user
whether he/she allows the incoming call to use features

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5 from the other subscriber profile data set) switch the mobile station MS to the correct subscriber identity module. Thus, an active intervention of the user may not be needed since for each mobile station terminating call MSTC (Fig. 2) the selection means SEL automatically "tunes" to
10 the correct SIM.

It should be noted that the designations in Fig. 1 and in other Figs. comprise descriptions using the language and the expressions as generally standardized for a GSM network
15 according to the ETSI GSM recommendations. However, the invention is generally applicable to any telecommunication network comprising a mobile radio communication network, for example the American AMPS System, wherein the units like the HLR, MSC/VLR are represented by analogous units.
20

Embodiment of the network

In terms of a GSM network, Fig. 1 shows for simplicity a combined MSC/VLR node. The home location register (home
25 data base) HLR and the visitor location register (visitor data base) VLR communicate with one another as indicated with the arrow. The MSC/VLR communicates with the terminal or mobile station MS, which is controlled by several subscriber identity modules SIM1...SIMn provided on one or
30 several cards as explained above. Each subscriber identity module SIM is identified by a specific identifier IMSI, namely IMSI1...IMSI_n, which is for example called the InternationalMobileSubscriberIdentity in a GSM-network. As is indicated with the plurality of subscriber mobile data sets SPDS1...SPDS_n in the home location register HLR and in the mobile switching center/visitor location register MSC/VLR, each IMSI is allocated to a directory number MSISDN (which in the GSM network is called the MobileSubscriberISDNNumber), i.e. MSISDN1...MSISDN_n. The
35 allocation or the link between each IMSI and each MSISDN is stored in the home location register HLR and/or in the VLR
40

5 i which the user is registered as part of each separate subscriber profile data set SPDS1...SPDSn as is indicated in Fig. 1.

10 As is conventionally done for one SIM card in Fig. 7, also in Fig. 1, when an IMSI is activated by means of the SIM card SIM1... SIMn in the terminal MS, information of the IMSI is signaled to the home location register HLR, which transmits an information on the current combination IMSI1-MSISDN1... IMSIn-MSISDNn to the visitor location register 15 VLR in order to enable the set up of calls. In the conventional case, the subscriber data (e.g. one subscriber profile data set) is copied from the home location register HLR to a respective MSC/VLR node where the mobile station MS is currently located. Thus, the (local) MSC/VLR node can 20 use the specific subscriber data defined in this subscriber profile data set for a communication with the mobile station.

25 According to the invention, as explained below in more detail, the home location register stores a plurality of subscriber profile data sets SPDS1-SPDSn for each subscriber corresponding to the plurality of subscriber identity modules in the terminal MS. Since several subscriber identity modules may be activated simultaneously 30 in the terminal MS, the MSC/VLR according to the invention has stored a plurality of subscriber profile data sets SPDS1-SPDSn corresponding to the activated subscriber identity modules for each subscriber. If by means of a registration message (in a GSM network generally the 35 Location _Update _Request message) a copy of the respective subscriber profile data set has been transferred from HLR to MSC/VLR, communications between the MSC/VLR and MS can be carried out by using several subscriber profile data sets simultaneously or alternately, since also the terminal 40 MS comprises a plurality of corresponding subscriber identity modules which can be selectively

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5 activated/deactivated for singular or parallel use. The transfer of the data from HLR to MSC/VLR can be done by the mobile switching center MSC in response to the registration message. Therefore, an exchange comprising switching means with a HLR, MSC/VLR which respectively store a plurality of

10 subscriber profile data sets enables the flexible use of several subscriber profile data sets in the PLMN. It should also be noted that, as explained before, all MSC/VLRs in the mobile radio communication network PLMN will communicate with the HLR in the same manner, e.g. whenever

15 the mobile station MS roams or moves to a different service area (e.g. a different cell of the network PLMN), than the MSC/VLR of the next service area will respectively request the transfer of the several subscriber profile data sets SPDS₁... SPDS_n from the respective home location register

20 HLR. Therefore, in all cells the usage of several subscriber profile data sets by means of several activated subscriber identity modules SIM₁... SIM_n in the terminal MS is enabled.

25 As explained above with reference to Fig. 1, according to the invention, a terminal MS may use several subscriber identity modules SIM₁.. SIM_n and the VLR/HLR respectively use several subscriber profile data sets SPDS₁... SPDS_n, wherein the HLR permanently stores all subscriber profiles

30 and wherein the MSC/VLR temporarily stores the several subscriber profiles when the mobile station MS is located in the service area thereof. Essentially all the conventional attach, detach, location updating, location cancellation and subscriber data updating procedures of a

35 conventional GSM-network can be extended to allow this functionality of the invention.

Essentially some or all of the conventional used messages need to be updated to comprise information about a

40 plurality of subscriber identity modules SIM which have been simultaneously activated in the mobile terminal MS.

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5 This will be explained for the separate procedures below. While the description will be made with reference to the standardized GSM signaling, it should be understood that the description is not limited thereto. Other similar messages in other mobile radio communication networks
10 according to other standards can in a completely analogous manner be updated.

It should be noted that in the following description of modifications in the standard GSM signaling procedures the
15 term "IMSI" is used solely for the mobile identity associated with the subscriber identity module SIM. However, the mobile radio communication network PLMN might take advantage of the concept of a temporary allocated IMSI (so-called TMSIs) for security reasons. In this respect the
20 term "IMSI" if intended to also comprise the concept of "TMSI". Only for reasons of simplification and clarification the term "IMSI" is used and any other identifier used in a GSM-network or a corresponding identifier in the network according to a different network-
25 standard can be used. It should also be noted that in some figures described below (for example Fig. 4) several messages are used simultaneously for different purposes and that the procedures are shown combined in one figure.

30 Attach procedure (registration of SIMs)

The attach procedure is a procedure that is carried out when a mobile station MS located in the servicing area of a specific visitor location register VLR is switched on for
35 the first time, e.g. the visitor location register VLR has as yet no information about the (new) mobile station MS in its servicing area (cell). On the other hand, the home location register HLR will of course have permanently stored the subscriber profile data sets SPDS1... SPDSn for
40 all subscriber identity module SIM1... SIMn for which the user has obtained a subscription from the provider of the

5 network PLMN. Of course, the situation in the attach procedure (where a VLR has no information about the new mobile station) is completely analogous to a situation where a mobile station served by a first mobile switching center/visitor location register VLR moves to a servicing
10 area serviced by the second MSC/VLR since also in this situation the (new) second VLR has as yet no information about the (new) mobile station MS. In such situation a location update request is sent, which can be seen to be analogous to an attach request, such that in the following
15 explanations of the attach procedure the location update request message is used.

Therefore, the situation is assumed where two or more subscriber identity modules SIM1-SIMn are inserted into a
20 mobile station MS and each subscriber identity module has stored in a home location register of the network a corresponding profile data set SPDS1... SPDSn. It is further assumed that the user has via a selection means selected one or more of the inserted subscriber identity
25 modules SIM1... SIMn and has activated these selected subscriber identity modules. In this situation the mobile station has as yet no indications in its data memory about a specific location area (cell). When the mobile station has been switched on, it will after locking on to a correct
30 frequency and receiving the location area information broadcast by the network, try to get access to the network and tell the system that it is new in the specific service location area. This is essentially done by a registration message to the switching means, i.e. the mobile switching
35 center/visitor location register MSC/VLR, of the network.

An attach procedure according to the invention is shown in Fig. 4. For the attach procedure a registration message (in GSM the so-called Location_Update_Request Message) is sent
40 to the switching means MSC/VLR where the mobile station MS is currently located, wherein the registration message

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5 includes the identifiers (IMSI_s) identifying the activated subscriber identity modules SIM₁... SIM_n in the mobile station in step S1. Since the registration message contains the identifiers of the activated subscriber identity modules, the MSC/VLR performs a signaling with one or more
10 home location registers HLR₁... HLR_n in order to provide the subscriber profile data sets corresponding to the activated subscriber identity modules (as identified by the identifiers) from the respective home location register to the MSC/VLR.

15

To achieve the provision of the subscriber profile data sets to the visitor location register VLR from the respective home location register HLR, the VLR will forward the registration message in GSM (the

20 Location Updating Request) to the respective HLR (or the respective HLRs) where the respective subscriber profile data sets according to the identifiers identifying the activated subscriber identity modules are located. As shown in Fig. 4, the registration message is forwarded from the
25 MSC/VLR to several home location Registers HLR₁... HLR_n, wherein the respective registration message S₂₁, S_{2n} respectively contain the list of identifiers (IMSI_s) associated with the respective home location register. Each message can contain one (in GSM) or more identifiers.

30

Next, in steps S₃₁, S_{3n} the respective home location register HLR₁... HLR_n will return a storage request message (in GSM an Insert_SubscriberData_Request message) including the data of the subscriber profile data sets SPDS₁... SPDS_n

35 belonging to the identifiers IMSI_s which characterize the activated SIMs in the mobile station MS. In response to the messages S₃₁... S_{3n} the MSC/VLR will store the respective subscriber profile data sets SPDS₁... SPDS_n belonging to the subscriber MS in the visitor location register VLR.

40 From now on the VLR can consider all IMSI_s (i.e. all corresponding subscriber identity modules) as being

5 attached, i.e. ready for a service in the communication network.

Finally, in step S4 the visitor location register VLR will provide the mobile station with a list of accepted IMSIs in
10 an acknowledgment message (in GSM a Location _ Update _ Request message) indicating at least the list of IMSIs after a successful location updating. The list of IMSIs are basically the indication parameters for the mobile station which indicate to the mobile station the subscriber
15 identity modules which have been successfully registered by the network.

In order to avoid that the user has to browse through several ones of the activated SIMs when a mobile station
20 terminating call is directed to the mobile station, the acknowledgment message in step S4 preferably also provides one or a number of subscriber identity modules addressing parameters SAPs which the MSC/VLR will always send when a call using specific features of a subscriber profile data
25 set is directed to the mobile station. Such a subscriber identity module addressing parameter SAP corresponds to (i.e. indicates) the registered profile which is needed by the incoming call. Therefore, for example SAP can indicate the IMSI in case of a GSM network. However, also other
30 specific profile indicators can be determined by the MSC/VLR and be provided as the SAP parameters to the mobile station MS which has requested the registration.

According to another embodiment of the switching means
35 MSC/VLR, the switching means may also itself determine from the specific features of the call whether more than one specific subscriber identity module must be used for handling the specific features of the requested mobile station terminating call. For example, the MSC/VLR can,
40 when receiving a mobile station terminating call, compare the specific requested services used by the call with the

5 specific basic services and supplementary services to which
the user has subscribed by means of several subscriber
identity modules and provide several parameters SAP for
those profiles which provide services with a best match to
the services needed by the pending call. The MSC/VLR will
10 then provide parameters SAP for those profiles which are
needed to handle the call.

The attach procedure S1, S21... S2n, S31... S3n, S4 as
described with reference to Fig. 4 is to be performed for
15 any subscriber identity module the user activates later in
the same manner. Whenever a SIM is activated by the user,
the attach procedure will thus be performed indicating the
IMSI associated with this specific new SIM and possibly
also the already activated SIMs. During an initial attach
20 procedure, the user may activate several subscriber
identity modules and the first registration message can
contain the list of the first activated subscriber identity
modules. In a case where the registration message during an
attach procedure only contains one identifier IMSI, the
25 switching means (i.e. the mobile switching center of the
network) can keep a record of all identifiers IMSIs of
previously activated and registered subscriber identity
modules in a memory and can generate the full list of all
identifiers from the previously stored identifiers and the
30 new identifier contained in the registration message.

Preferably, during each subsequent registration (attach)
procedure, the registration message shall also indicate
35 identifiers for all subscriber identity modules which have
already been activated by the user previously. This means,
that the list of IMSIs (for example shown in the message in
step S1 in Fig. 4) always consists of all the IMSIs
associated with activated SIMs, irrespective of whether
they have been already included in a previous attach
40 procedure or not. This allows the VLR to establish and
update links (i.e. correlations) between the individual

30

5 subscriber profile data sets belonging to one individual user. For example, for the afore-mentioned situation where a mobile station terminating call may require specific services from several subscriber profile data sets belonging to the same individual user, the VLR may browse 10 through several subscriber profile data sets all belonging to one user through the established links (access channels) such that the VLR can determine how many subscriber identity modules need to be activated in the mobile station.

15 Whilst Fig. 4 shows the general attach procedure when several SIMs are activated at the time of attachment and the subscriber profile data sets are distributed over several HLR1... HLRn (which may even be out of different networks), of course the simple case where only one provider for one network and one home location register HLR is provided, is also contained in Fig. 4 as special case. It should also be noted that the messages S51... S5n are not needed for the initial attach procedure since the 25 mobile station has not been registered before in a previous MSC/VLR (pMSC/VLR) during the initial attach procedure. The messages S51... S5n are necessary when the mobile station roams from one cell to an adjacent cell where a handover is performed as will be explained below.

30

Location updating procedure (service area handover)

Fig. 4 also shows the case of the signaling performed when a mobile station MS moves from one servicing area (cell) 35 served by a first mobile switching center/visitor location register MSC/VLR to another servicing area (cell) served by a second mobile switching center (visitor location register pMSC/VLR). When the switching means (the exchange) has detected that the mobile station moves into another service 40 area, the first MSC/VLR sends a separate location updating request message respectively to one or more of the home

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5 location register HLR1-HLRn respectively including one or a plurality of identifiers IMSIs identifying the activated subscriber identity module in the mobile station. According to the number of subscriber profile data sets currently available in the first VLR (corresponding to the number of
10 activated subscriber identity modules in the mobile station) the first MSC/VLR can send several messages S21 each containing only one identifier IMSI or one common location update request message containing the complete list of IMSIs to one home location register HLR.

15

Like in the initial attach procedure, the messages S31... S3n will be provided to the MSC/VLR. However, since the mobile station was previously registered in the previous mobile switching center/visitor location register pMSC/VLR,
20 the registration cancellation messages S51... S5n must be sent to the previous visitor location register such that the registration of the mobile station there is canceled. The cancellation messages may be sent individually for each IMSI or one cancellation message containing a list of IMSIs
25 can be sent.

Thus, the location updating function of the terminal is basically performed in the same way as in the conventional techniques, only that the Location _Updating _Request
30 messages sent by the terminal will contain the list of IMSIs belonging to the SIMs currently activated in the mobile station. The procedure is the same as the attach procedure, only that the VLR entries will have to be canceled with respective cancellation messages.

35

Thus, the above-described Fig. 4 shows the principle signaling when attaching or updating a location of a mobile station.

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5 IMSI detach procedure (SIM deactivation)

Fig. 5 shows a procedure which is performed when the user deactivates a specific subscriber identity module in the mobile station. That is, when a selected single subscriber 10 identity module is deactivated in the mobile station, the mobile station sends a detach message including an identifier identifying the deactivated subscriber identity module to the MSC/VLR in step S1. In this case, the message S1' in Fig. 5 only contains 1 IMSI.

15

For the case of a complete turn-off of the terminal, the detach message S1' contains the list of IMSIs belonging to all subscriber identity modules SIMs which have been deactivated by the activation/deactivation means AC. That 20 is, when the terminal is switched off completely, the list of IMSIs contains all currently activated SIMs via the indicated identifiers IMSI.

Similarly, as in the attach procedure, the detach messages 25 S21'... S2n' may be sent to the individual home location registers HLR1... HLRn separately for each IMSI. Alternatively, one common detach message S21' containing the respective list of IMSIs associated with the respective HLR may be sent to the respective home location register.

30

Paging procedure (mobile station terminating call)

Paging is a procedure which is performed in a situation when a call originated by another mobile station is pending 35 at the MSC/VLR which is currently responsible for handling the communication to the mobile station. Such terminating traffic may relate to a speech call, Fax, data call, SMS etc. Generally, paging is the procedure in order to search a mobile station and to request user status information 40 from the mobile station when it has been found. Paging is done before the call setup procedure which in turn includes

5 a procedure to indicate to the mobile station that a call
is available and should be received by the mobile station.
Paging is done according to standard procedures in the
network, as for example defined by the ETSI GSM
recommendations. The present invention does not require
10 modifications in terms of how the signaling for the paging
is performed. The identifier IMSI associated with the type
of call or connection to be set up is used for the paging.

That is, if for example a speech call has been initiated by
15 another subscriber (a mobile station or in fact fixed
terminal), the MSC/VLR would conventionally use the IMSI
(stored in the VLR for the respective user) and this IMSI
is used for paging the mobile station. After such a paging
procedure a call setup procedure then establishes a
20 communication path to the mobile station such that the
payload data may be transferred to the mobile station.

According to the invention a paging with a further IMSI
determined as being registered within the same mobile
25 station is not required if a communication path for the
mobile station has already been setup previously for
another IMSI. This can be checked by the MSC by using links
(link channels) between the profiles. That is, since
already one communication path may have been set up in
30 connection with a previous paging procedure, there is no
need to establish another one only for the reason that
another IMSI belonging to the same subscriber shall be
used.

35 To allow the MSC/VLR to detect whether a communication path
has already been set up, each subscriber profile data set
stored in the VLR may have associated with it an busy
parameter AC/DAC (see Fig. 1) which indicates that there is
already an existing connection between the respective
40 mobile station and the respective visitor location register
VLR. Thus, the busy parameter AC/DAC acts as a kind of

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5 "busy" flag indicating that another paging message is not required since there is already an existing connection. Thus, a paging message to the mobile station MS is only sent when all busy parameters AC/DAC of all subscriber profile data sets linked together are in a non-busy state.

10

In order to allow the MSC/VLR to look at other subscriber profile data sets belonging to the same subscriber, common access channels CAC are provided such that subscriber profile data of the subscriber profile data sets can be used commonly. Thus, the common access channels CAC allow the MSC/VLR to determine the status of all AC/DAC flags in all subscriber profile data sets belonging to the same user.

20 As explained above, another purpose of the links (link channels) between the profiles is to investigate, on the basis of specific services used by a mobile station terminating call, whether or not it is necessary to use more than one subscriber profile data set in the mobile station for handling the call. In this case the MSC/VLR can search through the individual subscriber profile data sets in the VSR until all the respective services are found. The MSC/VLR will then include a corresponding number of parameters SAP in a message on the already established communication path.

25

CM service establishment (call management service)

The CM service establishment is a procedure used when the user requests the set up of a call or the set up of other terminal originated user procedures.

35 When the terminal (mobile station) establishes a service for the connection management sublayer, it will indicate the IMSI associated with the SIM selected for the terminal originated traffic. That is, the mobile station includes an

35

5 identifier IMSI (possibly also several identifiers) of subscriber identity modules to be used for the originating activity also in a connection management message CM.

Interaction of subscriber profiles

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Above, it has already been described that the profiles associated with each activated SIM are linked in the visitor location register VLR of the network in order to provide a needed correlation. The purpose of the linking 15 via pointers (common access channels CAC) is to be able to take advantage of data in other profiles belonging to the same subscriber. This can be used to avoid unnecessary paging (as described above) and to enable certain supplementary services to recognize that calls for separate 20 profiles belong to the same user (e.g. for establishing a conference call between calls associated with different profiles).

Thus, for the case where several calls using different 25 profiles for the same subscriber are pending at the MSC/VLR or for the case when a single call is pending which however requires services from several profiles, the profiles can advantageously be linked in order to ensure that only one set of channels (communication channels and signaling 30 channels) is used on the radio interface for the individual calls or for the single more complex calls and for the signaling associated with the different profiles. On the other hand, the interaction of supplementary services in different profiles can be performed.

35

The feature that allows the common access to all profiles belonging to one subscriber is the continuous sending of identifiers IMSI belonging to activated subscriber identity modules during each attach or location update procedure.

40

5 As explained above, during the first registration, the mobile station receives the list of all IMSIs associated with subscriber identity modules SIM1... SIMn which have been activated by the user on the mobile station. The network will then perform the registration, i.e. the
10 storage of several subscriber profile data sets in the visitor location register VLR where the mobile station is located. During any subsequent attach procedure, when the user activates a further subscriber identity module, the network again receives a list of IMSIs associated with the
15 new subscriber identity profile as well as the already currently registered profiles (currently activated subscriber identity modules). Thus, whenever a new profile is added, the switching means receives information to establish the cross links (correlations) between the
20 individual profiles.

On the other hand, during a detach procedure it is only necessary to deactivate cross links for the profiles belonging to deactivated subscriber identity modules.

25 The following example illustrates the purpose of using common access channels between the subscriber profile data sets stored in the visitor location register VLR. The case relates to a call waiting (CW) supplementary service then
30 highlights the service interaction between profiles and the allocation of only one single set of channels between the switching means MSC/VLR and the mobile station:

It is assumed that the user has subscribed to the CW
35 service on one of his active profiles, i.e. when the user is busy with a call associated with this profile (referred to as profile SPDS1) and receives another call on the same profile, then the user is informed about the incoming call due to CW, allowing him to release the on-going call and
40 accept the incoming call instead.

5 When the second call comes in on another profile (referred to as profile SPDS2), then the MSC/VLR needs to check whether the subscriber is already busy on another active profile in order to prevent unnecessary paging of the terminal, as a connection already exists for the on-going
10 call associated with profile SPDS1. Otherwise the MSC/VLR would treat this as a call to another user on another terminal, i.e. the terminal would be paged an a set of required channels would be assigned for signaling and communication purposes. Hence, profile SPDS1 needs a link
15 (a link channel) to profile SPDS2 (and any other active profile).

For the incoming call, the VLR will examine each of the other active profiles via the link, whether the subscriber
20 is busy or not by checking the "busy" flag for each profile. If he is busy, the call is only signaled to the terminal, if the subscriber has subscribed to CW on the profile(s) for which he is busy. If CW is not subscribed, the incoming call is released with a busy indication
25 provided to the caller. If call waiting is subscribed, then the call is offered to user. If the user accepts the waiting call by releasing the on-going call (or by another procedure offered by other subscribed supplementary services like call hold), the same communication channel is
30 used for the accepted waiting call as for the previous active, but now released call (or in the case of applied call hold, held call).

Other supplementary services operating on parallel calls
35 make use of the links between profiles in order to check whether the profile associated with the call to which the service shall be applied includes a subscription to the service. These supplementary services are Call Hold service (which allows to alternate between two calls, i.e. one is
40 on hold, the other is in active communication phase) Multi Party Call (conference call between three or more parties),

5 and the Call Transfer service (which allows a user to connect a call in active communication and a held or alerting call and refraining himself from the communication).

10 Update of profiles in the VLR

There are two situations where an updating of profiles in a VLR may be performed. The first case is when certain subscriber data in the profile has changed (due to a change 15 subscription arrangement between the provider and user). The second case is when the terminal has moved to another MSC/VLR service area (cell), i.e. the location updating as was already explained with reference to Fig. 4. In the latter case the profile (set of subscriber data) has to be 20 transferred to another VLR.

For the case where only one specific subscriber profile data set has changed, the MSC/VLR sends a separate Location_Update_Request message for each subscriber profile 25 data set to a corresponding home location register HLR where such new subscriber data is stored. The information contained in the request message indicates the IMSIs identifying the subscriber profile data records to which the transfer data record relates.

30 Alternatively, for a more efficient updating procedure, the MSC/VLR can send one combined Location _Update _Request message for all records belonging to the same service provider, i.e. the list of IMSIs sent along with the 35 request as received from the terminal with one IMSI pointing out the same service provider. The HLR will then send the data for all records as part of the location update procedure and cancel the old location by only one Location_Cancellation_Request message.

5 Fig. 6 shows such a combined updating of subscriber profiles in the VLR. The messages S21... S2n in Fig. 6 correspond to the messages shown in Fig. 4.

Operation in non-supporting networks

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When the mobile station roams to another network which does not allow a registration and activation/deactivation of several subscriber profiles, the mobile station receives a location updating reject message from a switching means of 15 the new network indicating that the location updating can only be performed for one specific subscriber identity module, whereupon the mobile station either selects a default subscriber identity module or prompts the user to select one. At this stage, the user may change the SIM at 20 any time by performing the activation/deactivation procedures provided by the mobile station.

The second option is to let a non-supporting network ignore the list of IMSIs a location updating request except for 25 one IMSI. The accepted IMSI will then correspond to a default IMSI or default subscriber identity module. The network will indicate the successful location updating for only the accepted IMSI. In turn, the terminal can inform the user of the non-support in the network and which SIM is 30 accepted as active. The user can then disable the default SIM and enable another SIM if required.

That is, when the new network returns a response message indicating that it does not support several subscriber 35 identity modules then the mobile station may react to this by sending a standard location updating message with only one identity which is the default identity to be used in non-supporting networks. Alternatively the mobile station can indicate the default identity to be used in non- 40 supporting networks as the one which is recognized by the network and no further action is needed.

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Industrial applicability

As explained above, in a telecommunication system comprising a switching means and one or more mobile stations as described above, the subscriber can use several subscriber profile data sets simultaneously. Each profile can relate to a separate account, i.e. can be charged separately. Each profile may preferably consists of a different set of basic and supplementary services according to the needs associated with each of the profiles.

Therefore, the subscriber is in full control of which profile is used by inserting the relevant subscriber identity modules SIMs into the mobile station and by activating or deactivating these inserted SIMs.

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Furthermore, since each inserted SIM having an associated IMSI may belong to different users, there is the potential possibility that the mobile station having inserted several such SIMs of different users can be shared by several users.

The subscriber can also select which SIM shall be in use in case of roaming to a network which does not support the service (i.e. the network only supports the common one-to-one relation between subscriber, terminal and SIM). The subscriber may thus choose to subscribe to profiles of different service providers (also of different networks) simultaneously as each subscriber identity modules SIM is associated with the service provider.

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Thus, the invention goes beyond the conventional use of a multiple subscriber profile MSP service since the subscriber has an active control over several subscriber identity modules simultaneously. In fact to invention is actually to replace the conventional MSP service. The invention is not restricted to a GSM network and

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5 corresponding signaling messages in other networks can easily be updated according to the teaching of the present invention.

Therefore, the invention is not limited by the above-
10 described embodiments and the teachings described above. In particular, the invention can comprise features that result from various combinations of features as disclosed in the attached claims.

15 Reference numerals in these claims only serve clarification purposes and do not limit the scope of the invention.

Claims

1. A mobile station (MS1-MS4) for performing communications in a telecommunication system (TELE) including at least one mobile radio communication network (PLMN) using several subscriber profiles, comprising:
 - a) receiving means (H) for receiving two or more subscriber identity modules (SIM1-SIMn) each having stored in a home location register (HLR) of said at least one network (PLMN) a corresponding subscriber profile data set (SPDS1...SPDSn, MSP) simultaneously in the mobile station (MS); and
 - b) activation/deactivation means (AC) for selectively activating/deactivating one or more of said subscriber identity modules (SIM1-SIMn) for a communication in said network (PLMN).
2. A mobile station (MS1-MS4) according to claim 1, characterized in that said subscriber identity modules (SIM1-SIMn) are provided on a single SIM card (MSIM) and said receiving means (H) comprises a single SIM card holding device (MSL) for receiving said single SIM card (MSIM).
3. A mobile station (MS1-MS4) according to claim 1, characterized in that said subscriber identity modules (SIM1-SIMn) are provided on separate SIM cards (SIM1-SIMn) and said receiving means (RC) comprises several SIM card holding devices (SL1-SLn) for receiving said separate SIM cards (SIM1-SIMn).

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4. A mobile station (MS1-MS4) according to claim 1,
characterized by
a display means (DSP) for indicating to the user which
of the received subscriber identity modules (SIM1-
10 SIMn) are active and/or which of the activated
subscriber identity modules (SIM1-SIMn) have been
successfully registered in the network (PLMN) and/or
the available basic services and the supplementary
services per subscriber identity module (SIM1-SIMn)
15 and/or a default subscriber identity module (SIMn).
5. A mobile station (MS1-MS4) according to claim 1,
characterized by
a selection means (SEL) selecting a specific
20 subscriber identity module (SIM1-SIMn) in accordance
with the characteristics of a desired mobile station
originating call.
6. A mobile station (MS1-MS4) according to claim 1,
25 *characterized by*
a default setting means (DSM) for setting one of said
subscriber identity modules (SIM1-SIMn) as a default
module to be registered and/or the be used for
outgoing calls.
30
7. A mobile station (MS) according to claim 1,
characterized in that
said mobile station (MS) comprises a selection means
(SEL) for selecting one of said subscriber identity
35 modules (SIM1-SIMn) and for switching to the selected
subscriber identity module (SIM1-SIMn) for performing
communications dependent on a subscriber identity
module addressing parameter (SAP) indicating that a
call corresponding to an identifier (IMSI) determined
40 as being registered in said mobile station (MS) uses a
specific subscriber profile data set (SPDS1-SPDSn)

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5 corresponding to a specific subscriber identity module (SIM1-SIMn) in said mobile station (MS).

8. A mobile station (MS1-MS4) according to claim 1,
characterized in that

10 said activation/deactivation means (AC) sends a registration message (Location_Updating_Request(list of IMSIs)) to a switching means (MSC/VLR) of said network (PLMN) including a list of identifiers (IMSI斯) identifying the activated subscriber identity modules (SIM1-SIMn) in said mobile station (MS) to request the storage of subscriber profile data sets (SPDS1...SPDSn, MSP) corresponding to the activated subscriber identity modules (SIM1-SIMn) from at least one home location register (HLR) in said switching means (MSC/VLR).

9. A mobile station (MS1-MS4) according to claim 8,
characterized in that

25 said at least one mobile radio communication network (PLMN) is a network (PLMN) according to the GSM-standard, wherein said activation/deactivation means (AC) sends a Location_Update_Request message containing a list of IMSIs (InternationalMobileSubscriberIdentity) identifying said activated subscriber identity modules (SIM1-SIMn) to a mobile switching centre/visitor location register (MSC/VLR) of said network (PLMN).

30 10. A mobile station (MS1-MS4) according to claim 9,
characterized in that

35 said IMSIs used for identifying the mobile station identity associated with the subscriber identity module (SIM1-SIMn) are temporary allocated IMSIs (TMSIs).

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5 11. A method for performing communications between mobile stations (MS1-MS4) in a telecommunication system (TELE) comprising at least one mobile radio communication network (PLMN) using several subscriber profiles, comprising the following steps:

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- a) inserting two or more subscriber identity modules (SIM1-SIMn) into a mobile station (MS1-MS4) each subscriber identity module (SIM1-SIMn) having stored in a home location register (HLR1-HLRn) of said at least one network (PLMN) a corresponding subscriber profile data set (SPDS1...SPDSn, MSP); and
- b) selecting one or more of the inserted subscriber identity modules (SIM1-SIMn) and activating/deactivating selected subscriber identity modules (SIM1-SIMn).

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12. A method ("attach") according to claim 11, characterized by the following step:

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- c) sending a registration message (Location Updating Request(list of IMSIs)) to a switching means (MSC/VLR) of said network (PLMN) where said mobile station (MS) is located including at least one identifier (IMSI) identifying at least one activated subscriber identity module (SIM1-SIMn); and
- d) providing the subscriber profile data sets (SPDS1...SPDSn, MSP) corresponding to the activated subscriber identity modules (SIM1-SIMn) from at least one home location register (HLR) to the switching means (MSC/VLR).

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5 13. A method according to claim 12,
characterized by the following step:

10 e) sending to the mobile station (MS) indication parameters (IMSIMs) indicating to the mobile station (MS) the subscriber identity modules (SIM1-SIMn) which have been registered by said network (PLMN).

15 14. A method according to claim 13,
characterized in that
when a call is directed to said mobile station (MS) a subscriber identity module addressing parameter (SAP) indicating that a call using a specific subscriber profile data set (SPDS1-SPDSn) corresponding to a specific subscriber identity module (SIM1-SIMn) is pending at said mobile station (MS1-MS4) is send to said mobile station, whereupon said mobile station (MS) switches to the particular subscriber identity module (SIM1-SIMn) for performing communications.

25 15. A method according to claim 12,
characterized in that
said steps c) and d) are carried out whenever a new subscriber identity module (SIM1-SIMn) is activated.

30 16. A method according to claim 12,
characterized in that
said at least one mobile radio communication network (PLMN) is a network (PLMN) according to the GSM-standard, wherein in said step c) said mobile station (MS) sends a Location_Update_Request message containing a list of IMSIs (InternationalMobileSubscriberIdentity) identifying said activated subscriber identity modules (SIM1-SIMn) to a mobile switching centre/visitor location register (MSC/VLR) of said network (PLMN); and

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in said step d) the mobile switching centre/visitor location register (MSC/VLR) forwards the Location_Update_Request message including the list of IMSIs (InternationalMobileSubscriberIdentity) to one or more home location registers (HLR1-HLRn) of said at least one network (PLMN), said one or more home location registers (HLR1-HLRn) returning an Insert_SubscriberData_Request message containing a list of subscriber profile data sets corresponding to said IMSIs (InternationalMobileSubscriberIdentity) and said subscriber profile data sets being stored in the visitor location register (VLR) of said switching means (MSC/VLR).

20 17. A method according to claim 13,

characterized in that

said at least one mobile radio communication network (PLMN) is a network (PLMN) according to the GSM-standard, wherein in said step e) as said indication parameters (IMSI) a list of accepted IMSIs (InternationalMobileSubscriberIdentity) is sent to the mobile station (MS) in a Location Updating_Accept message.

30 18. A method according to claim 16 or 17,

characterized in that

said IMSIs used for identifying the mobile station identity associated with the subscriber identity module (SIM1-SIMn) are temporary allocated IMSIs (TMSIs).

35 19. A method ("detach") according to claim 11,

characterized in that

when a selected single subscriber identity module (SIM1-SIMn) is deactivated, said mobile station (MS) sends a detach message (IMSI_Detach_Req) including an

5 identifier (IMSI_s) identifying the deactivated
subscriber identity module (SIM₁-SIM_n) to a switching
means (MSC/VLR).

10 20. A method ("detach") according to claim 11,
characterized in that
when a plurality of subscriber identity modules (SIM₁-
SIM_n) are deactivated, said mobile station (MS) sends
a detach message (IMSI_Detach_Req(List of IMSIs))
respectively including an identifier (IMSI)
15 identifying a deactivated subscriber identity module
(SIM₁-SIM_n) to a switching means (MSC/VLR) of the at
least one network (PLMN), wherein said switching means
(MSC(VLR) forwards to the respective home location
register (HLR₁-HLR_n) of said at least one network
20 (PLMN) a corresponding detach message (IMSI_Detach_Req
(List of IMSIs associated with HLR₁-HLR_n)) including
the identifier (IMSI_s) of the respectively deactivated
subscriber profile identity module (SIM₁-SIM_n) for
which a respective subscriber profile data set (SPDS₁-
25 SPDS_n) is stored in said home location register (HLR₁-
HLR_n).

21. A method according to claim 11,
characterized in that
30 each of said subscriber profile data sets (SPDS₁-
SPDS_n) stored in said home location register (HLR₁-
HLR_n) comprise one or more of the following data: an
identifier (IMSI) indicating that a subscriber profile
data set (SPDS₁-SPDS_n) belongs to a specific
35 subscriber (user), a directory number parameter
(MSISDN), basic service data, supplementary service
data, location data and an busy-parameter (AC/DAC)
indicating whether a specific subscriber identity
module (SIM₁-SIM_n) is activated in said mobile station
40 (MS).

5 22. A method ("paging") according to claim 21,
characterized in that
when a call is to be routed to said mobile station
(MS), a switching means (MSC/VLR) determines the user
to which the call is to be routed on the basis of the
10 identifier (IMSI) indicated in said call, determines
the status of the busy-parameter (AC/DAC) in all
subscriber profile data sets (SPDS1-SPDSn) associated
with this user and sends a paging message to said
mobile station (MS) only when all busy-parameters
15 (AC/DAC) have a non-busy status.

20 23. A method ("CM service") according to claim 11,
characterized in that
said mobile station (MS) includes one identifier
(IMSI) of the activated subscriber identity modules
(SIM1-SIMn) in a connection management message (CM).

25 24. A method ("modified attach") according to claim 15,
characterized in that
in addition to the identifier (IMSI) of the newly
activated subscriber identity module (SIM1-SIMn), said
list also contains the identifier (IMSI) of subscriber
identity modules (SIM1-SIMn) which have previously
been activated and registered in said at least one
30 network (PLMN).

35 25. A method ("network requirements - profiles") according
to claim 12, 15, 20 or 23, characterized in that
the subscriber profile data sets (SPDS1-SPDSn) stored
in the visitor location register (MSC/VLR) for
activated subscriber identity modules (SIM1-SIMn) of
the same subscriber (user) are linked through common
access channels, wherein subscriber profile data of
one subscriber profile data set (SPDS1-SPDSn) can be
40 used commonly.

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5 26. A method ("separate and common updating of profiles")
according to claim 11, characterized in that
when said mobile station (MS) moves from one servicing
area served by a first mobile switching center/visitor
location register (pMSC/VLR) to another servicing area
served by a second mobile switching center/visitor
location register (pMSC/VLR), the second mobile
switching center/visitor location register (MSC/VLR)
sends a separate location updating request message
(Location_Update_Req) respectively to one or more home
10 15 location registers (HLR1-HLRn) including one
identifier (IMSI) identifying one or all activated
subscriber identity modules (SIM1-SIMn) in said mobile
station (MS), wherein said respective home location
register (HLR1-HLRn) copies the respective subscriber
profile data set (SPDS1-SPDSn) into the second visitor
20 25 location register (MSC/VLR).

27. A method ("terminating traffic") according to claim
14, characterized in that
said subscriber identity module selection parameter
(SAP) indicates a subscriber identity module in said
mobile station for which a subscriber profile data set
is currently registered.

30 28. A method ("non-supporting networks") according to one
of claims 25-27, characterized in that
when said mobile station (MS) roams to another network
(PLMN) which does not allow a registration and
activation/deactivation of several subscriber
35 40 profiles, the mobile station (MS) receives a location
updating response message from a switching means
(MSC/VLR) of the another network (PLMN) indicating
that the location updating can only be performed for
one subscriber identity module (SIM1-SIMn), whereupon
said mobile station (MS) either selects a default

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5 subscriber identity module (SIM1-SIMn) or prompts the user to select one.

29. A method ("non-supporting networks") according to one of claims 25-27, characterized in that

10 when said mobile station (MS) roams to another network (PLMN) which does not allow a concurrent registration of several subscriber identity modules simultaneously, the switching means (MSC/VLR) of the another network (PLMN) performs a location updating procedure for a
15 default subscriber identity module (SIM1-SIMn) of a default subscriber profile data set (SPDS1-SPDSn), wherein the default subscriber identity module is defined by said another network or a default subscriber identity module selected as default by the
20 the user.

30. A mobile radio communication network ((HLR, MSC/VLR, EX; PLMN) for performing communications between mobile stations (MS1-MS4) using several subscriber profiles, comprising:

- a) at least one home location register (HLR) storing a plurality of subscriber profile data sets (SPDS1-SPDSn) for each subscriber of the mobile radio communication network (PLMN);

- b) a mobile switching center (MSC) for transferring in response to a registration message (Location Updating Request(list of IMSIs)) received from a mobile station (MS) and including identifiers (IMSI) identifying a plurality of activated subscriber identity modules (SIM1-SIMn) from said at least one home location register (HLR) to a visitor location register (VLR) a copy of a plurality of subscriber profile data sets (SPFD1-SPDSn) corresponding to said activated

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5 subscriber identity modules (SIM₁-SIM_n) for each subscriber; and

10 c) a visitor location register (VLR) for storing said plurality of subscriber profile data sets (SPFD₁-SPDS_n) simultaneously for each subscriber.

15 31. A network (HLR, MSC/VLR, EX) according to claim 30, *characterized in that* when a call from a mobile station (MS) is pending at said mobile switching center (MSC), said mobile switching center (MSC) transfers to a called mobile station (MS) SEL a subscriber identity module addressing parameter (SAP) indicating that the call directed to said mobile station (MS) uses a specific subscriber profile data set (SPDS₁-SPDS_n) corresponding to a specific activated subscriber identity module (SIM₁-SIM_n) in said mobile station (MS) .

20 25 32. A network (HLR, MSC/VLR, EX) according to claim 30, *characterized in that* said mobile switching center (MSC) sends to the mobile station (MS) indication parameters (IMSI's) indicating to the mobile station (MS) the subscriber identity modules (SIM₁-SIM_n) which have been registered in said visitor location register (VLR) by said network (PLMN) .

30 35 33. A network (HLR, MSC/VLR, EX) according to claim 30, *characterized in that* each of said subscriber profile data sets (SPDS₁-SPDS_n) stored in said at least one home location register (HLR₁-HLR_n) comprise one or more of the following data: an identifier (IMSI) indicating a specific subscriber profile data set (SPDS₁-SPDS_n), a directory number parameter (MSISDN), basic service

5 data, supplementary service data, location data and an
busy-parameter (AC/DAC) indicating whether a specific
subscriber identity module (SIM1-SIMn) is activated in
said mobile station (MS).

10 34. A network (HLR, MSC/VLR, EX) according to claim 33,
characterized in that

when a call is to be routed to said mobile station
(MS), said mobile switching center (MSC) determines
the user to which the call is to be routed on the basis
15 of the directory number (MSISDN) indicated in said
call, determines the status of the busy-parameter
(AC/DAC) in all subscriber profile data sets (SPDS1-
SPDSn) associated with this user and sends a paging
message to said mobile station (MS) only when all
20 busy-parameters (AC/DAC) have a non-busy status.

35. A network (HLR, MSC/VLR, EX) according to claim 30,
characterized in that

25 the subscriber profile data sets (SPDS1-SPDSn) stored
in the visitor location register (MSC/VLR) for
activated subscriber identity modules (SIM1-SIMn) of
the same subscriber (user) are linked through link
channels (CAC), wherein subscriber profile data of one
30 subscriber profile data set (SPDS1-SPDSn) can be used
commonly.

36. A network (HLR, MSC/VLR, EX) according to claim 33,
characterized in that

35 said subscriber identity module selection parameter
(SAP) is one of the group consisting of: a called
party number (MSISDN) or a subscriber profile data set
indication parameter (SAP).

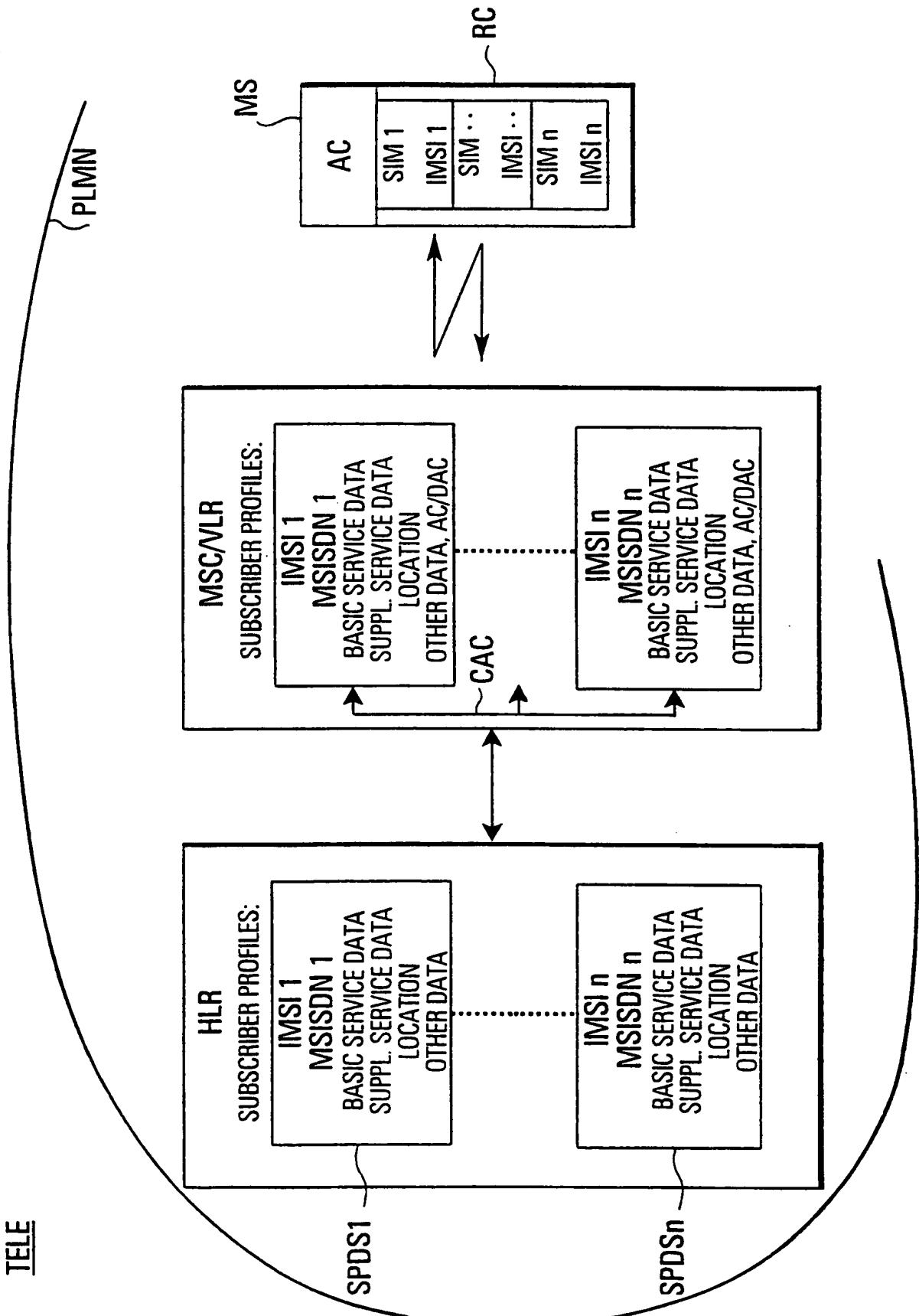
40 37. A telecommunication system (TELE) comprising at least
one network (HLR, MSC/VLR) according to claims 30-36

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and at least one mobile station (MS1-MS4) according to
claims 1-10.

1/6

FIG.1

2/6

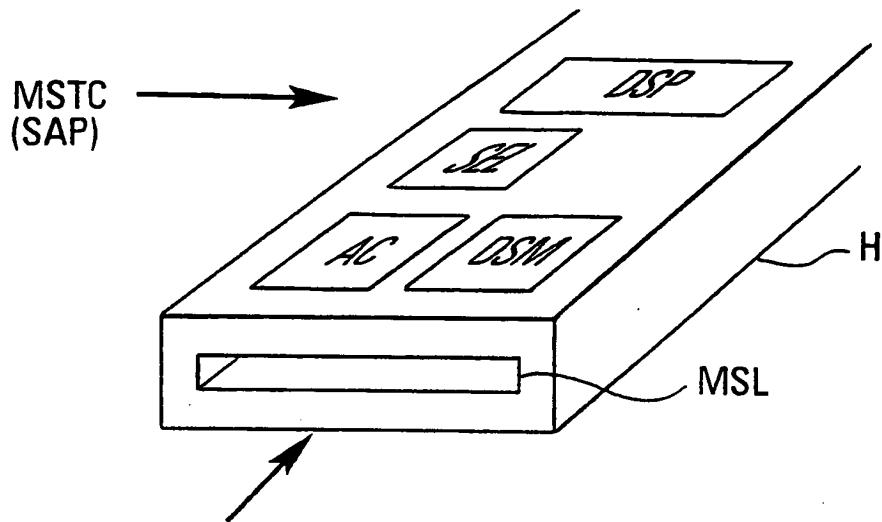
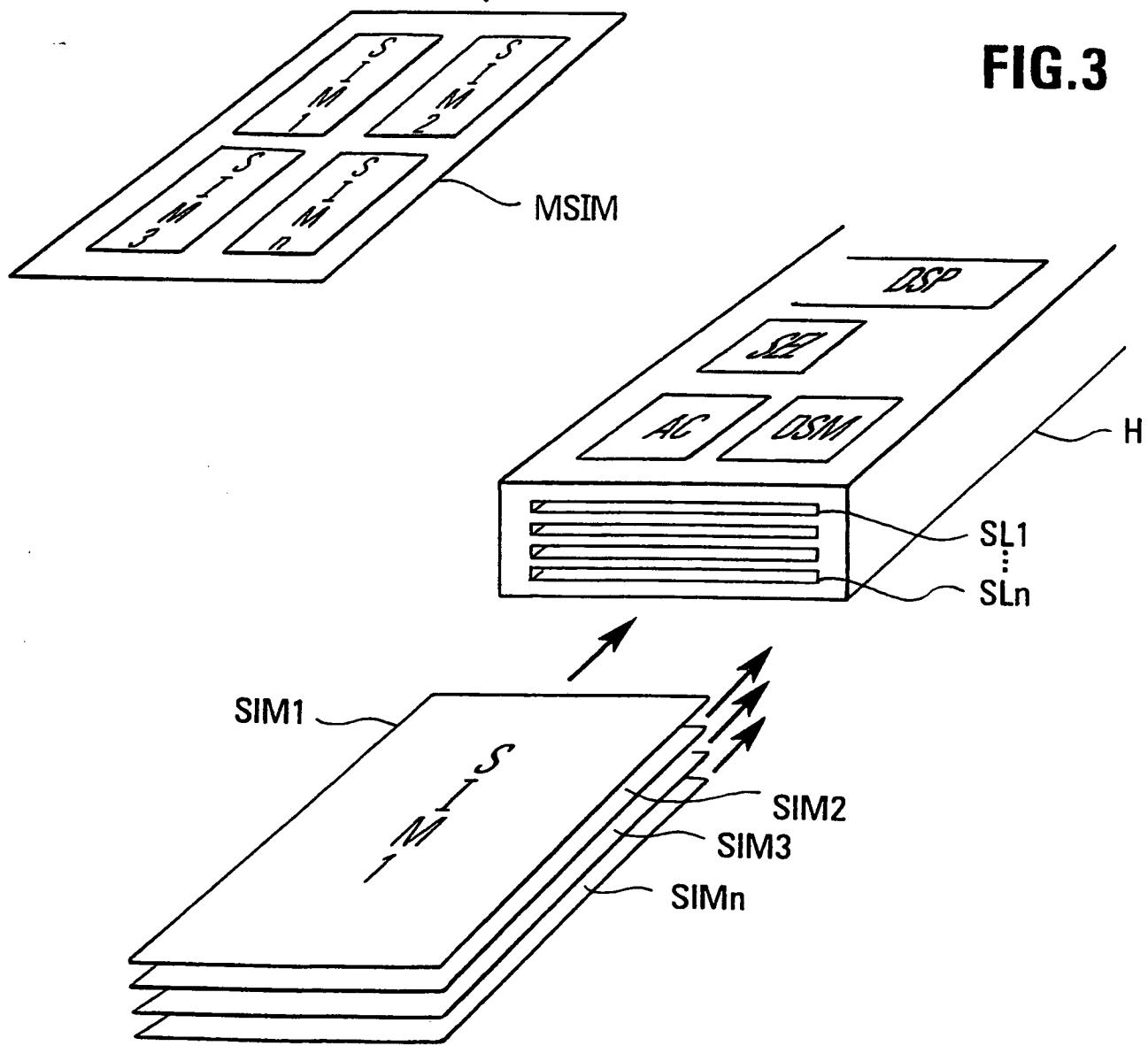
FIG.2**FIG.3**

FIG.4

SIMULTANEOUS LOCATION UPDATING OR ATTACH FOR SEVERAL IMSIs

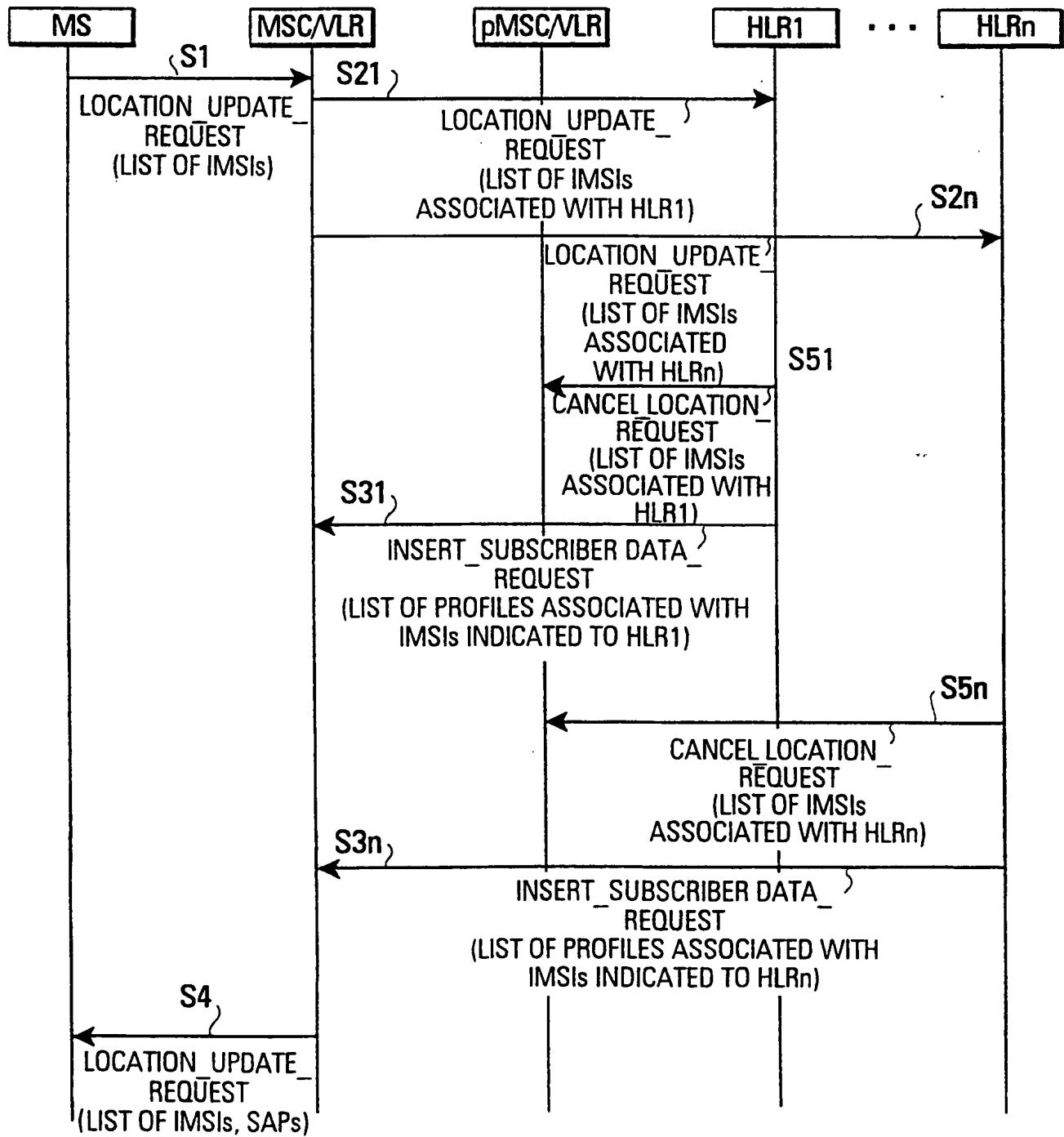


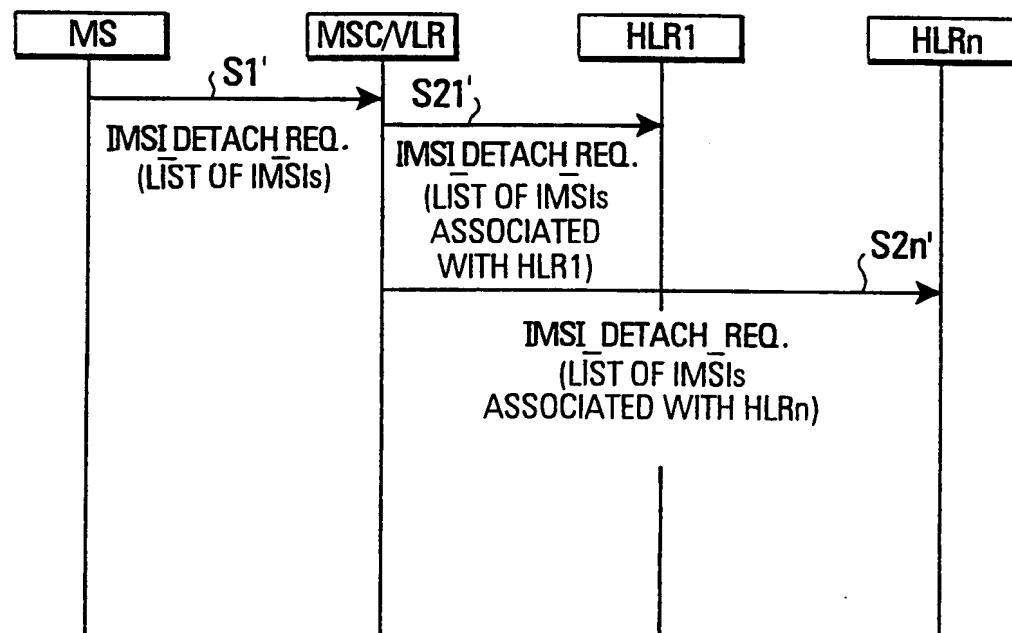
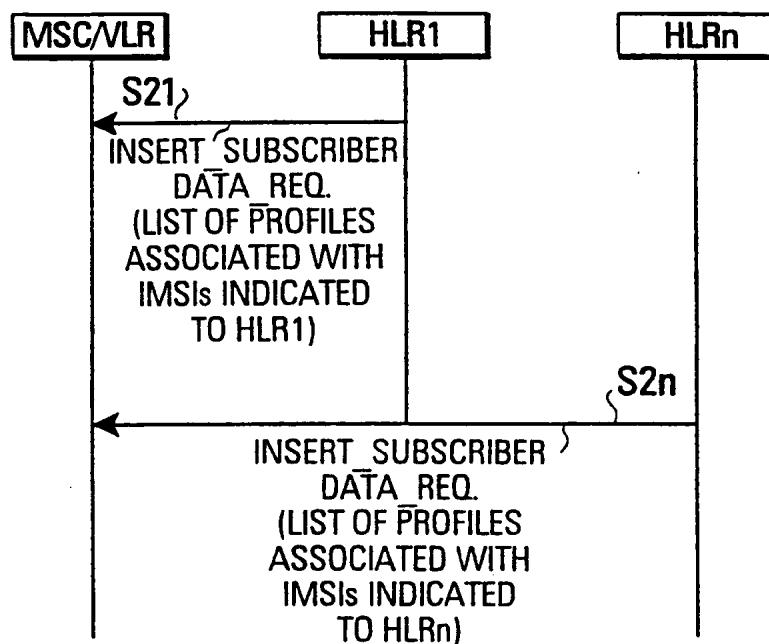
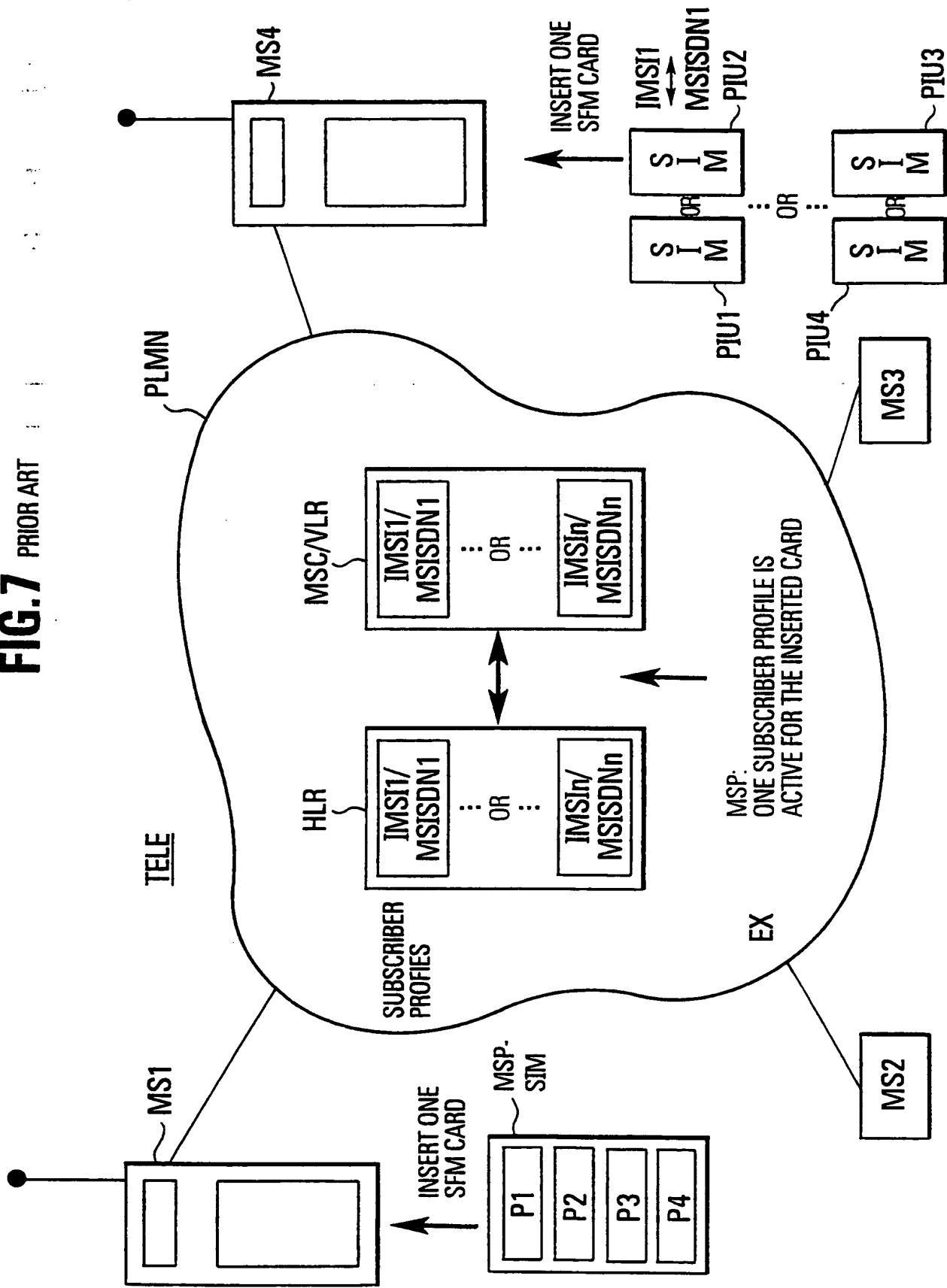
FIG.5**SIMULTANEOUS DETACH FOR SEVERAL IMSIs**

FIG.6

UPDATING OF PROFILE FOR SEVERAL IMSIs



6/6

FIG.7 PRIOR ART

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/03556

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 6 H04Q7/38 H04Q7/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	page 7, line 24 -page 8, line 4	4-7,21
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Y	EP 0 526 981 A (NOKIA MOBILE PHONES LTD) 10 February 1993 (1993-02-10) column 2, line 51 -column 4, line 38 ---	4-7
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

30 September 1999

Date of mailing of the international search report

08/10/1999

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/03556

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International Application No

PCT/EP 99/03556

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